The Effect of Added Nitrogen on First and Second Year Corn After Alfalfa

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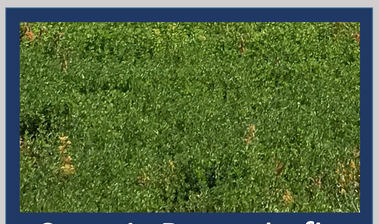
Introduction



Step 1: Bacteria fix nitrogen for alfalfa.

Step 2: Nitrogen within alfalfa becomes available as the plant decomposes

Step 3: Corn uses that nitrogen to grow and develop.

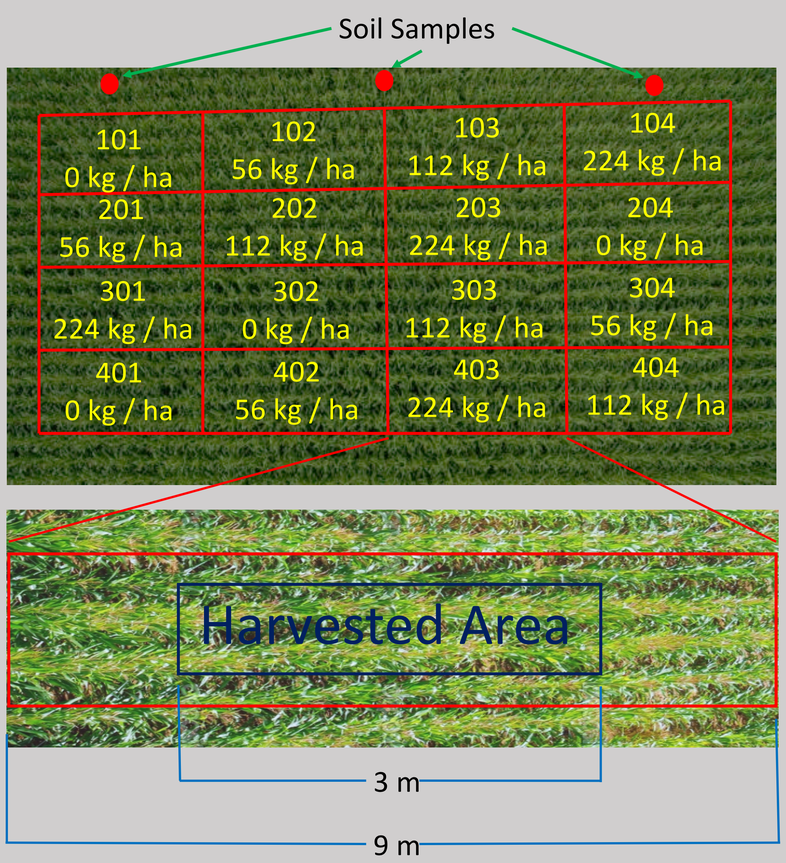
The nitrogen fixed for alfalfa lowers the amount of nitrogen that farmers need to apply to the following crops. Currently, the Utah Fertilizer Guide gives two calculations to find nitrogen application recommendations. The first uses a blanket credit of 112 kg N ha^{-1}. The second calculation uses soil test nitrogen (STN) results.

Objective

1) To determine how much nitrogen is required by first and second year corn to maximize dry matter yield, forage quality and farm profit.
2) To compare the economic optimum nitrogen rate (EONR) to the recommended nitrogen rates to see if these recommendations should be reevaluated.

Materials and Methods

Study Sites: 36 sites have been studied from 2014 to 2017 using a randomized complete block. 27 sites were first year corn, and 9 were second year corn. N application had 4 treatments and 4 reps. 3 soil cores were taken to 90 cm.



Data analysis: Data from the first and second year sites were pooled separately to be analyzed with an ANOVA test generated using the SAS program PROC MIXED. Yield predictions were calculated using a quadratic + plateau curve.

Results and Discussion

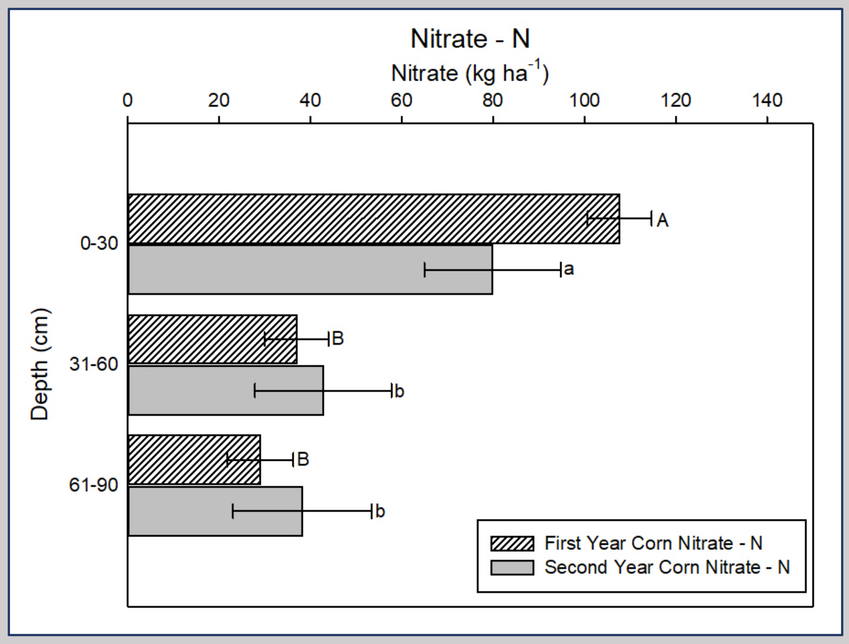


Figure 1. The average nitrate – N through the soil profile. First and second year data were pooled and analyzed separately.

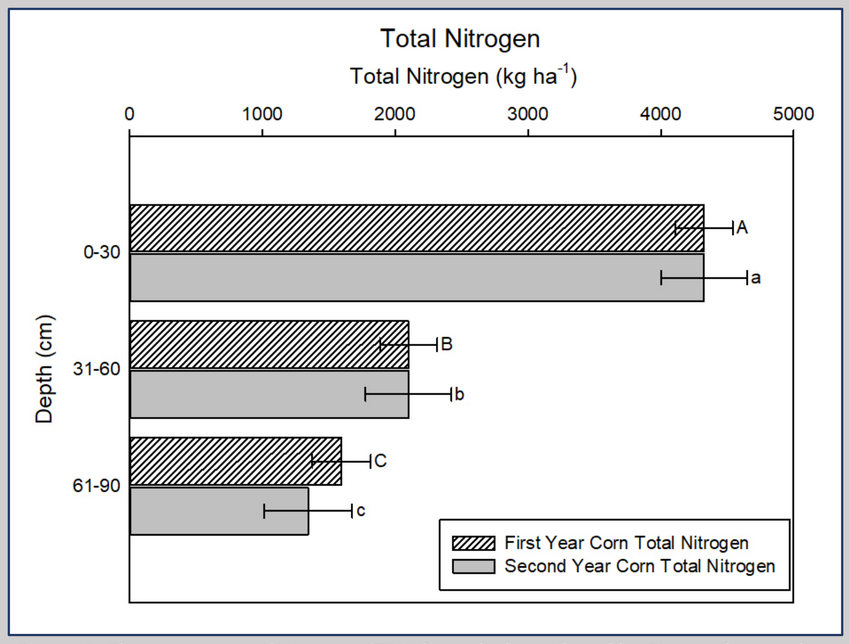


Figure 2. The average total nitrogen (TN) through the soil profile. First and second year data were pooled and analyzed separately.

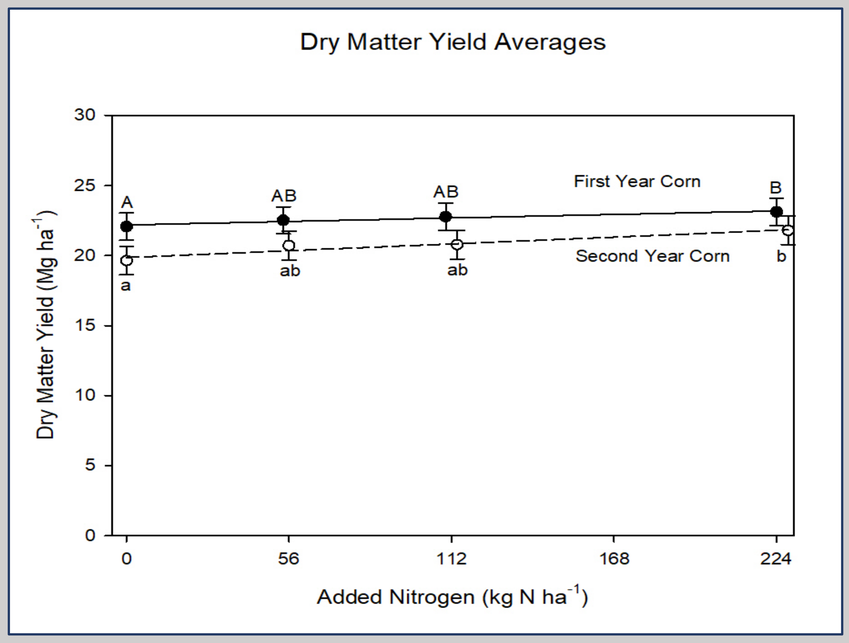


Figure 3. The average dry matter yield. First and second year data were pooled and analyzed separately.

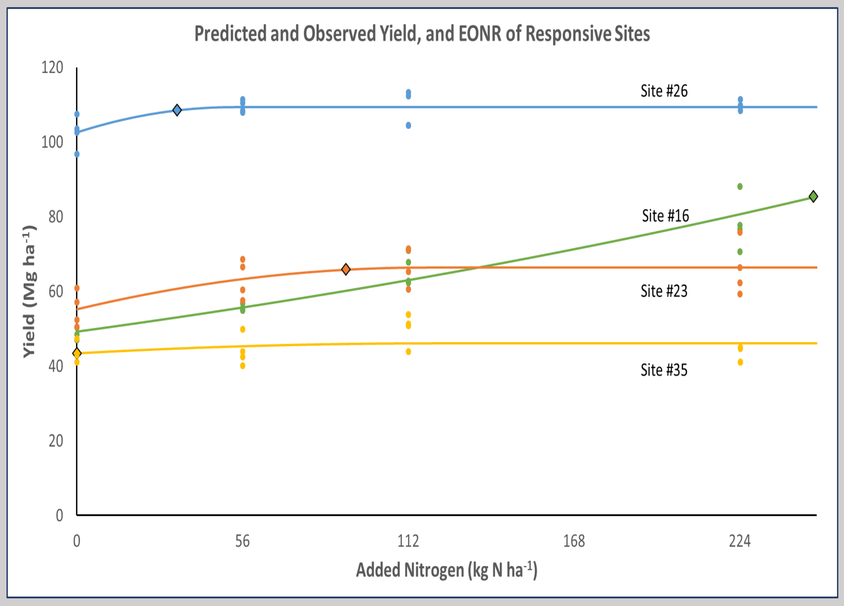


Figure 4. Observed yield is represented by the dots, while predicted yield is represented by the lines. The EONR for each site is marked with a diamond on the predicted yield line. Water content was assumed to be 65%.

Results and Discussion Cont.

First Year Corn EONR and Nitrogen Application Recommendations

ID	County	Recommendation$_{STN}$	Difference$_{STN-EONR}$	Recommendation$_{Blanket}$	Difference$_{Blanet-EONR}$	EONR	EONR Yield
		kg N ha^{-1}					Mg ha^{-1}
1	Beaver*	0	0	168	168	0	71.6
2	Box Elder	233	233	168	168	0	63.7
3	Box Elder	128	128	168	168	0	73.6
5	Cache	106	106	168	168	0	81.9
7	Iron	126	126	168	168	0	61.1
8	Sevier	29	29	168	168	0	63.4
9	Weber	112	112	168	168	0	68.5
10	Beaver*	0	0	168	168	0	67.4
12	Box Elder	28	28	168	168	0	56.0
13	Box Elder*	38	38	168	168	0	32.1
15	Cache	200	200	168	168	0	75.3
17	Carbon	144	144	168	168	0	49.6
18	Iron	51	51	168	168	0	66.7
20	Millard	142	142	168	168	0	69.5
23	Weber ǂ	174	75	168	69	99	67.1
24	Beaver	77	77	168	168	0	70.5
25	Box Elder	0	0	168	168	0	62.3
26	Iron ǂ	115	68	168	121	47	109.5
28	Uintah	263	263	168	168	0	50.7
29	Weber	67	67	168	168	0	77.0
30	Beaver	0	0	168	168	0	73.1
31	Box Elder	225	225	168	168	0	52.0
32	Cache	31	31	168	168	0	70.6
33	Sevier	0	0	168	168	0	48.2
34	Uintah	119	119	168	168	0	60.1
35	Weber	0	0	168	168	0	45.2
36	Sevier	53	53	168	168	0	64.7
	Average		86		163		

Table 1. Both recommended nitrogen application rates compared to the EONR of each site.
* Soil tests were taken to 60 cm rather than 90 cm.
ǂ Sites showed yield response to added nitrogen.

Second Year Corn EONR and Nitrogen Application Recommendations

ID	County	Recommendation$_{STN}$	Difference$_{STN-EONR}$	Recommendation$_{Blanket}$	Difference$_{Blanet-EONR}$	EONR	EONR Yield
		kg N ha^{-1}					Mg ha^{-1}
4	Box Elder	2	2	280	280	0	57.5
6	Cache	223	223	280	280	0	68.5
11	Beaver*	0	0	280	280	0	72.3
14	Box Elder	0	0	280	280	0	51.5
16	Cache ǂ	205	-19	280	56	224	85.4
19	Juab	124	124	280	280	0	54.4
21	Sevier	159	159	280	280	0	56.9
22	Uintah	220	220	280	280	0	47.1
27	Sevier	164	164	280	280	0	63.0
	Average		97		255		

Table 2. Both recommended nitrogen application rates compared to the EONR of each site.
* Soil tests were taken to 60 cm rather than 90 cm.
ǂ Sites showed yield response to added nitrogen.

Conclusions

1) After alfalfa, first year corn fields had, on average, 156.9 kg nitrate ha^{-1} and 8,022 kg TN ha^{-1} in the top 90 cm. Second year fields had 145.3 kg nitrate ha^{-1} and 7,770 kg TN ha^{-1} to the same depth. This potential nitrogen credit caused first and second year corn to show very little response to added nitrogen. However, if irrigation is improperly managed the nitrogen responses could be much greater, see site 16.

2) The comparison between the recommended nitrogen application rates and the EONR suggests that our current recommendations, for both first and second year corn, may be too high.

Acknowledgments

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